DOCUMENT RESUME

ED 325 319 SE 051 654

TITLE	Trash Treasures, Level 5. Teacher Guide. Operation Waste Watch.
INSTITUTION	Virginia State Dept. of Waste Management, Richmond. Div. of Litter & Recycling.
PUB DATE	80
NOTE	73p.; For related documents, see SE 051 649-656.
AVAILABLE FROM	Department of Waste Management, Division of Litter Control and Recycling, James Monroe Building, Eleventh Floor, 101 North Fourteenth Street, Richmond, VA 23219 (Free of charge to Virginia elementary teachers, outside Virginia contact for price). Contact Operation Waste Watch for the audiovisual materials and other items to complete this unit.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	*Elementary School Curriculum; Elementary School Science; *Environmental Education; *Grade 5; Instructional Materials; Interdisciplinary Approach; Intermediate Grades; Science Activities; Science Education; Science Instruction; Science Materials; *Solid Wastes; Teaching Guides; *Waste Disposal
IDENTIFIERS	*Virginia

ABSTRACT

Operation Waste Watch is a series of seven sequential learning units which addresses the subject of litter control and solid waste management. Each unit may be used in a variety of ways, depending on the needs and schedules of individual schools, and may be incorporated into various social studies, science, language arts, health, mathematics, and artistic activities. Each unit consists of a teacher's guide, filmstrip-cassette set, activity cards, test materials, duplicating masters, and a poster. This document contains the teacher's guide and activity cards for the fifth-grade unit entitled "Trash Treasures." In this unit, students discover that while many things are recycled by nature, quite a number of modern products must be recycled by people. They learn that recycling and resource recovery can help save important resources which are often lost when items are tossed into a trash receptacle. Thirteen individual- and 19 class-activity cards are included. (CW)

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Operation Waste Watch

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Trash Treasures

Level
5

Teacher Guide

INTRODUCTION

OPERATION WASTE WATCH is a series of 7 sequential learning units which addresses the subjects of litter control and solid waste management. The curriculum, developed by the Division of Litter Control, Virginia's state litter prevention agency, is designed for classroom use in kindergarten through grade six.

Each OPERATION WASTE WATCH unit may be used in a variety of ways, depending on the needs and schedules of individual students and schools. Each unit is interdisciplinary in approach and may be incorporated into the various science, social studies, and health curricula Virginia teachers are presently using. Language arts, mathematics, and artistic activities are also highlighted. Each unit consists of a teacher's guide, filmstrip-cassette set, activity cards for class and individual student use, test materials, coloring book duplicating masters or comic books, and a colorful poster. Each elementary school in Virginia may receive a complete set of OPERATION WASTE WATCH without cost.

Flexibility is a key element of the OPERATION WASTE WATCH program. The sequence of the units within the curriculum may be changed to suit the abilities of students in the individual school. For this reason, teachers should become familiar with each of the units. Each instructor should also feel free to present concepts found in previous units. This is especially important for upper elementary students who are unfamiliar with the solid waste vocabulary and ideas presented in earlier units. The materials in each unit are color-coded for easy identification.

The teacher is free to shorten or lengthen the series of activity cards which are the heart of the unit, to suit her/his schedule or to build her/his own unit around the OPERATION WASTE WATCH auxiliary materials.

OPERATION WASTE WATCH is based on WASTE IN PLACE, the elementary school curriculum recently created by Keep America Beautiful. Solid waste management has become a very important environmental topic, but it is a subject which is too often superficially addressed in elementary textbooks.

WASTE IN PLACE was the first sequential elementary curriculum in the United States to address the concepts of proper waste handling. WASTE IN PLACE is available at cost to all localities around the country organized under the Clean Community System of Keep America Beautiful and to other interested groups. In developing OPERATION WASTE WATCH for Virginia's elementary schools, the Division of Litter Control changed the format of WASTE IN PLACE and designed supplementary activities and materials, including audiovisual aids.

OPERATION WASTE WATCH differs significantly from WASTE IN PLACE in its approach to the subject matter only in Levels 2 and 3. The Division believes that the ideas presented in these 2 units merit special emphasis in a study of solid waste problems in Virginia. Level 2, LITTER POLLUTION, addresses pollution problems associated with litter, while Level 3, TRASH TRENDS, examines packaging trends in relationship to current solid waste problems.

Field Testing

Two versions of OPERATION WASTE WATCH were piloted during the 1979-1980 school year in over 125 classrooms in 14 school systems with very positive results. A summary of the results of this field testing is available from the Division. Based on the results of the piloting, portions of the draft curriculum were revised in the fall of 1980.

Changing Littering Behavior

In addition to equipping students with important facts about litter and solid waste management, OPERATION WASTE WATCH is designed to help students modify their everyday waste disposal habits.

A study of students' waste disposal behavior was conducted in the spring of 1980 by two psychologists from Virginia Polytechnic Institute and State University, Mr. John Cope and Dr. Scott Geller. Their study confirmed that students learn from involvement with OPERATION WASTE WATCH. Student test performance following the curriculum was statistically higher than performance on the pretest. (Grades 1, 4 and 6 were the levels involved in the study.) Almost all of the teachers indicated that the OWW program materials were interesting to the students.

Most of the teachers felt that their students' littering be-

havior had decreased as a direct result of the program. The Division of Litter Control encourages teachers to emphasize recycling and the proper disposal of wastes. With continued positive reinforcement of proper behavior, and practice by the children of proper disposal techniques, teachers will see an even greater reduction in littering behavior.

The Virginia Plan: A Model Program to Prevent Littering

The DIVISION OF LITTER CONTROL was established in 1977 to control, prevent, and eliminate litter from the state to the maximum practical extent.

One-half of Division funds are granted annually to the localities of the state to finance local litter prevention programs. Over 90% of the counties and cities annually apply for and receive grant money from the Division. To assist these localities in organizing effective, comprehensive, long-range litter control programs, the Division has developed an organizational package, THE VIRGINIA PLAN: A MODEL PROGRAM TO PREVENT LITTERING, which is available to all community leaders interested in developing local programs. OPERATION WASTE WATCH is one component of THE VIRGINIA PLAN.

The Division is encouraging local litter prevention coordinators to work closely with schools in each locality. Many localities are promoting the implementation of OPERATION WASTE WATCH in their schools.

CONTACT THE DIVISION OF LITTER CONTROL FOR THE NAME AND PHONE NUMBER OF THE LITTER CONTROL COORDINATOR IN YOUR LOCALITY.

Virginia Division of Litter Control
Washington Building
Capitol Square
Richmond, Virginia 23219
(804) 786-8679

OPERATION WASTE WATCH UNIT TOPICS

Level K

Natural and Man-Made Objects

Students practice classification skills and learn to differentiate between natural and man-made objects in indoor and outdoor environments. They also learn to identify litter.

Level 1

Waste Out of Place

Students classify objects into two categories, "waste objects" and "useful objects." In addition, they learn to identify litter and dispose of their own waste items properly.

Level 2

Litter Pollution

Students study the negative effects of littering: injury to humans and animals, environmental pollution, and wasted resources. In addition, they explore a littered area, study the characteristics of litter, and learn how to clean it up.

Level 3

Trash Trends

Students trace historical changes in consumption and packaging. They also study the roles of packaging in everyday life and learn the meaning of "biodegradable."

Level 4

Let's Waste Less Waste

Students examine changes which can be made in their homes to reduce solid waste and litter. They also explore various sources of litter in their communities.

Level 5

Trash Treasures

Students discover that while many things are recycled by nature, quite a number of modern products must be recycled by people. They learn that recycling and resource recovery can help save important resources which are often lost when items are tossed into a trash receptacle.

Level 6

Community Solutions for Solid Waste Pollution

Students study their own locality's solid waste problems and design a model waste disposal plan for an imaginary community.

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LEVEL 5

RATIONALE

This series of instructional materials, developed by the Division of Litter Control, is designed to help elementary students deal effectively with solid waste problems encountered in their everyday lives. It will also prepare them to deal as adults with the growing problem of waste disposal facing each community. In Virginia, litter pickup alone is estimated to cost $25 million annually.

Litter is a very accessible pollutant and one children can comprehend. Children may be able to do very little to solve other environmental problems; but they can learn to dispose of waste properly, help recycle some items, and come to understand how their own behavior affects the environment. A solid waste management unit is an excellent place to begin creating environmental awareness. From this point we can begin building in our youth a strong sense of environmental stewardship and pride.

Disposal of solid waste in an environmentally-sound manner is becoming increasingly difficult as space for sanitary landfills runs out and pollution-free incineration becomes more costly. Resource recovery units offer an excellent solution in areas where enough solid waste is generated to make recovery economically practical. Such a solution makes it even more important to see that all waste is put in containers and kept in the reclamation system.

Fifth grade students can understand the principles of cycles in nature, and the recycling and reuse of refuse in the human community.

If your students have not studied previous OPERATION WASTE WATCH units, feel free to borrow ideas, activities, and filmstrips from the other kits to prepare your students for the Level 5 ideas.

MAJOR IDEAS OF THE LEVEL 5 UNIT

1. There are many cycles in nature.
2. Some recycling occurs naturally.
3. A number of modern, man-made products cannot be recycled naturally and must be recycled by people.

4. Removing usable materials from solid waste (resource recovery) is a process which can decrease landfill problems, and save money and energy.
5. Using recovered materials to make new things (recycling) helps conserve important resources.
6. Some man-made items necessary to our society are not easily recycled.

UNIT OBJECTIVES

At the completion of the unit, the student will be able to:

1. COMPLETE the recycling pattern of one natural substance or event;
2. COMPLETE the recycling pattern of one man-made substance;
3. DEFINE a few key terms associated with recycling processes and solid waste management;
4. RECOGNIZE that **people** are responsible for disposing of waste properly and designing new systems to handle refuse;
5. RECOGNIZE that people can use their imaginations to invent new uses for waste objects.

ELEMENTARY SCIENCE PROGRAM OBJECTIVES

The following science program objectives should be emphasized in Level 5 science programs and are incorporated into this unit (see reference 7, pg. 8):

1. Observing—The student will use all senses in the identification of objects and their properties, changes in properties, controlled observations, and ordering of a series of observations.
2. Classifying—The student will classify objects, actions, and phenomena.
3. Measuring—The student will learn to use standard units of measurement in determining length, area, volume, weight, and temperature.
4. Collecting and Organizing Data—The student will collect and organize information about a problem, communicate it verbally or graphically, and present these data so that trends can be analyzed.
5. Using Equipment—The student will assemble and use the appropriate tools and apparatus needed to investigate a problem.
6. Summarizing—The student will describe orally, in writing, or nonverbally conclusions about the processes and products of scientific inquiry.

INSTRUCTIONAL STRATEGY

1. Review this guide and study all unit components thoroughly. Also become familiar with the other OPERATION WASTE WATCH units.
2. Decide which elements of the unit kit and which activity cards you will use. Add your own ideas as necessary or pull activities from OPERATION WASTE WATCH UNITS on other grade levels.
3. Prepare all necessary materials and arrange for any outside speakers or field trips.
4. **Be sure to find out what your community is doing to fight the littering problem. Contact the Division of Litter Control or your local government.**
5. Administer the pretest to your students. Use the results to modify your unit plans as necessary.
6. Briefly discuss the topic and title of the unit with your class. Tell the students about some of the activities they will be involved in.
7. Explain the contents of the unit kit to your students.
8. Hang the poster in a prominent spot in your classroom.
9. Present the filmstrip to the class. During the showing, stop the filmstrip to allow for discussion of important ideas.
10. Order the **Junior Ecology Club Certificates** from the Division.
11. Proceed with the INDIVIDUAL AND CLASS ACTIVITY CARDS.
12. Present the comic books at some appropriate point in the unit. Use these as a motivational and teaching tool.
13. At the completion of the unit, present the filmstrip once again as a review activity. Elicit discussion of ideas the children have learned.
14. Administer the posttest to your students.
15. Return all unit components to the box for use by the next class.
16. **Be sure to review and reinforce proper waste disposal habits throughout the school year!**

TIME FRAME

The complete Level 5 unit will take approximately 6 weeks (30 thirty to forty-minute learning sessions).

If you desire to teach a shortened version of the unit, we recommend you use only the CORE ACTIVITY CARDS. Each core card is labeled CORE in the upper left-hand corner.

Using only the core activities should cut the required instructional time to about 4 weeks. Another method is to use the activity cards and other materials as guidelines for developing your own shortened unit.

Allow 20-30 minutes for administering the tests at the beginning and end of the unit. Each filmstrip viewing should take about 15 minutes.

EVALUATION INSTRUMENTS

Included in this unit are duplicating masters for the student test. Administer the test to your class just before beginning the unit. This test should be used as a screening device to identify children who will need special help, and those who will need to complete only a minimum number of the INDIVIDUAL ACTIVITY CARDS to strengthen their knowledge.

Administer the test once again, immediately after the class completes the unit. Posttest results will help determine whether or not your students attained the unit objectives. Comparison of the pretest and posttest results for each student can help you determine the effectiveness of your unit.

FILMSTRIP AND CASSETTE

The filmstrip and cassette set provided with this unit is designed for use as both an introductory and review activity.

Before using the ACTIVITY CARDS, present the filmstrip to the class as an introduction to the unit. This may be done in small groups or as a total class activity. Present the filmstrip again at the end of the unit as a review of major ideas.

This guide contains a copy of the filmstrip script with asterisks (*) indicating spots in the program where we encourage you to stop the cassette and filmstrip to allow for class discussion. The cassette has audible tones and should be used with a manually-operated filmstrip projector. **The filmstrip is brief and is to be used as a teaching tool. During the showing, please encourage group discussion of the ideas presented.** The script may be read aloud by an adult if for any reason a cassette recorder is not available or if this delivery method is preferred.

When the filmstrip is used as a review activity, it may be most helpful to read the script rather than use the audiotape. Proceeding at a comfortable speed, ask the children to respond orally to the questions raised.

INDIVIDUAL ACTIVITY CARDS (IACs)

The 13 IACs have been designed for use by small groups or individual students. You may hand them out to individuals, or set up learning centers using the IACs as the foundation. In some classes, the IACs may have to be combined with the CLASS ACTIVITY CARDS (CACs) and used as a lesson plan for the whole class.

We encourage you to modify, delete, and create additional IAC activities as necessary. IACs which provide more advanced activities are marked with asterisks (*). Students who do very well on the pretest may need to use only a few of the IACs. The IACs may be completed before or in conjunction with the CACs.

CLASS ACTIVITY CARDS (CACs)

The 19 CACs provide a sequential set of instructional activities. They are basically a lesson plan presented in card form to simplify modifications, additions, deletions, or restructuring by the teacher. The CACs are designed as total class activities.

COMIC BOOKS

In the kit box you will find 25 copies of the comic book entitled, Help a Can When You Can! Before teaching the unit, read the comic yourself. You may decide to design study questions based on the story to gauge your students' vocabulary and comprehension skills.

At some point during the unit, pass out the books to your students. Allow the children to read the story out loud. Discuss the theme of the comic book as a class or in small groups.

If you have extra time, you may decide to have your students act out a skit based on the story. Perhaps they could present their skit to another class. Or the students could exercise their creativity by writing and illustrating their own litter prevention comics to take home to their families.

Be sure to return the comic books to the unit box so the next class can use them.

JUNIOR ECOLOGY CLUB PROGRAM

Since the fall of 1978, the Division of Litter Control has sponsored a successful ECOLOGY CLUB PROGRAM for grades 6-12. Because of the favorable input from teachers in the lower grades, the Division has developed a JUNIOR ECOLOGY CLUB PROGRAM for students in kindergarten through grade 5 who have completed at least one unit of OPERATION WASTE WATCH.

To obtain membership certificates for your students, simply **duplicate** the JUNIOR ECOLOGY CLUB ORDER FORM included in this guide and return a completed copy to the Division.

The certificates may be used simply as a final reward for your students once they have completed the OPERATION WASTE WATCH unit, or used to begin an active ecology club program with your class. A list of suggested club activities will be included with your certificates.

COMING IN THE FUTURE

A major advantage of the activity card format used in OPERATION WASTE WATCH is that additional cards may be added and revisions made at minimal expense to the Division.

The Division will continue to evaluate the program throughout the coming years. As a result of this evaluation, new and revised ACTIVITY CARDS will be developed periodically and sent to your school.

ORDERING REPLACEMENT MATERIALS FOR THIS UNIT

Replacement copies of the filmstrip, cassette, poster, teacher's guide, activity cards, and coloring/comic books for this unit may be obtained without charge from the Division of Litter Control.

DUPLICATING MASTERS

This unit contains the duplicating masters listed below. Photocopy these materials as necessary:

(1) PRETEST AND POSTTEST
(2) VOCABULARY WORKSHEET

VOCABULARY

The following is a list of terms of major significance in this unit. The function of this list is, first of all, to provide a **glossary for the teacher.** We do not recommend rote memorization of these definitions. The exercises provided in the activity cards should help the students understand these terms on an experiential level. Remember, DEFINITIONS DEVELOPED WITHOUT AN EXPERIENCE BASE ARE MEANINGLESS TO CHILDREN.

As your class proceeds through this unit, we suggest that you help the students develop definitions for the terms—in their own words. Each student should be able to recognize the terms in written form by the end of the unit.

1. BIODEGRADABLE—material capable of decomposing naturally, by biological processes
2. CYCLE—a continuous pattern in which certain events or conditions are repeated, often at regular intervals
3. DECOMPOSE—to break down to basic elements, to rot
4. ENERGY RECOVERY—incinerating waste in such a way that the heat from burning can be used to make steam for heating, cooling, and/or to make electricity
5. INCINERATE—reduce by burning the amount of waste to be disposed of
6. LEACHATE—liquid (such as rainwater) which has drained through something (such as solid waste) and dissolved some of the material
7. LITTER—man-made (or man-used) solid waste that is disposed of in the wrong place or allowed to escape from a container
8. NUTRIENTS—substances that are used in the growth and repair of living things
9. ORGANIC WASTE—once living materials, or a product of a living thing—egg shells, coffee grounds, leaves, grass clippings, food scraps, hair, etc.
10. RESOURCE—something that can be used to make something else—wood into paper; old cans into new cans; old bottles into new ones; old newspapers into cardboard; or a source of supply
11. RESOURCE RECOVERY—taking usable materials (resources) out of solid waste
12. SANITARY LANDFILL—a large, outdoor area for waste disposal where discarded materials are usually compacted before being covered with a layer of earth; a place to bury solid waste
13. SOLID WASTE—all useless, unwanted, or discarded materials—refuse, trash, garbage, debris
14. SOLID WASTE MANAGEMENT—everything that has to be done to get rid of all the waste produced in the community—including collection, transportation, and processing of waste

REFERENCES

1. Divisions of Elementary, Secondary, and Vocational Education, Virginia Department of Education, Environmental Education Guide K-12. Richmond: n.p., 1974.
2. Essence, Indianapolis: Addison-Wesley Publishing Company, 1971.
3. Division of Litter Control, Department of Conservation and Economic Development. Litter Control Project Guide for Elementary School Teachers. Richmond: Spencer's Printing, 1978.
4. University of California. OBIS—Outdoor Biology Instructional Strategies. Berkley: University of California, 1975.
5. Falkie, Thomas V. "Bureau of Mines Research Activities in Secondary Resource Recovery" in Phoenix Quarterly. 7(3): 2-9. Washington, D.C.: Institute of Scrap Iron and Steel, Inc., 1975.
6. "Recycled House Explores Solid Waste Option" in Phoenix Quarterly. 9(2): 6-7. Washington, D.C.: Institute of Scrap Iron and Steel, Inc., 1977.
7. Division of Science and Elementary Administration, Virginia Department of Education. Program Goals and Objectives for Elementary Science. Richmond: n.p., 1978.
8. Keep America Beautiful. Waste in Place. New York: n.p., 1979.

LEVEL FIVE FILMSTRIP

Trash Treasures (Length: 8:28)

Narration	Visuals
1. (Title slide)	
2. (Credit slide)	
3. In nature, all plants and animals are part of a food chain.	Grasshopper
4. Here is a grasshopper eating a plant.	Grasshopper Eating Grass
5. Now a frog catches the "hopper."	Frog and Grasshopper
6. Later a hawk spots the frog.	Hawk and Frog
7. The frog will make a tasty meal for the hawk and its young.	Hawk with Frog in Talons
8. The hawk will use some of the food energy and minerals it gets from eating the frog to help it stay alive. And when the hawk feeds its babies, some of the food energy will be passed on to the young birds.	Hawk with Young
9. After a few years, the hawk will die. Its body will decay. Tiny plants and animals living in the soil will help to recycle important minerals from the hawk back into the earth.	Dead Hawk

10. The minerals from dead plants and animals provide a natural fertilizer for the soil—giving new plants a rich source of the elements they need for good growth. The plant-grasshopper-frog-hawk-soil-new plant cycle is called a food chain.

Food Chain Diagram

11. There are many cycles in nature. A cycle is a **circle** of happenings or events. These events can be repeated over and over again.

    Here is a diagram of the water cycle. In this cycle, water which falls to the ground as rain forms tiny droplets which go up into the clouds when the earth warms up. This process is called evaporation. The droplets of water then group themselves together inside a cloud and fall again as rain. This cycle continuously repeats itself all around our planet.

Water Cycle Diagram

12. The carbon dioxide-oxygen cycle is another cycle you may want to learn about. (*)

Carbon Dioxide-Oxygen Cycle

13. In a cycle, the same raw materials are used over and over again. For example, leaves fall from trees, decompose, and enrich the soil. The fallen leaves are natural litter which is good for the environment because they help growing plants.

Leaves on Forest Floor

14. While nature can recycle natural objects and paper, it's not able to recycle some man-made products such as aluminum, plastic, and glass. It is up to people to recycle these materials.

Automobile and Scrap Metal

15. When man-made objects, such as automobiles, lose their usefulness, they still contain some valuable resource materials which nature can't recycle.

Junk Automobiles

16. What materials do you think we might find in this junkyard which people can recycle. (*)	Junk Automobiles
17. The resources we can recover from waste materials are very valuable.	Crane and Solid Waste
18. For example, about 75 pounds of a 5,000 pound automobile is aluminum metal.	Automobile
19. This aluminum can be recycled and may become beverage cans or aluminum lawn furniture.	Aluminum Cans
20. Do you think we should bother to recycle our waste materials? (*)	Scrap Metal
21. Think about the plant-grasshopper-frog-hawk-soil-new plant cycle. What would happen to the new plants if all the mineral resources stayed in the hawk's body and none were returned to the soil? (*) Of course, the answer is the new plants would find it hard to live. Unless people recycle the resources in our man-made wastes, many will remain locked up and unusable.	Food Chain Diagram
22. In the United States today, each person creates over a ton of waste every year.	Group of People
23. If we lock up all the resources in our solid wastes, someday we may begin to run out of raw materials needed to make new things. We would also have to build more and more sanitary landfills to hold the mountains of waste and garbage.	Landfill
24. And a lot of this trash would end up as litter. The world would look very ugly piled high with rubbish.	Trash and Debris

25. It's fortunate that some of the materials we throw away such as food scraps and paper are **biodegradable.** These materials don't waste much space in the landfill because in a short time they break down to basic elements.

Decomposing Organic Waste

26. But instead of throwing vegetable scraps, eggshells, and coffee grounds into the garbage can, people could use these wastes at home to make compost for fertilizing their gardens and fields.

Field

27. Used newspapers will also decompose in the soil and can help feed young trees and shrubs.

Newspaper Cycle

28. Fortunately, people continue to invent new ways to recycle our **nonbiodegradable** wastes, such as metals, plastic, and glass.

    Did you know that we can now recover 350,000 tons of lead from the millions of car batteries Americans discard every year?

Automobile Battery

29. The scrap lead is recycled by smelting it in a blast furnace. The lead can then be used in new batteries or in other lead products.

Battery Cycle

30. By recycling the lead in automobile batteries, we recover a scarce resource. And we no longer need to send old batteries to landfills.

Truck Dumping at Landfill

31. Another type of resource we can get from solid waste is energy. Energy can be generated by burning refuse in special incinerators.

Incinerator

32.	The energy that could be recovered each year from our nation's trash would equal the energy we get now from about 45 million tons of coal. . .	Coal
33.	. . . or more than 200 million barrels of oil!	Oil Barrels
34.	By increasing the production of energy in the United States, we could decrease the amount of oil and other energy sources we now get from other countries.	Oil Well
35.	We have seen that aluminum, lead, rich energy sources, and other treasures will be buried in our landfills unless people recycle them.	Landfill
36.	What do you see in this picture that could be reused or recycled? (*)	Closeup of Trash
37.	The total value of all resources which could be recycled in the United States is 1.5 billion dollars!	$1,500,000,000
38.	Here are the chemical symbols for several valuable resources Americans can recover from their waste products. Do some research to find out which elements each symbol represents.(*)	Chemical Symbols
39.	Some people are using their imaginations to turn ordinary trash into treasures. Old bottles, cans, and even cardboard tubes can be used to construct buildings.	Construction Site
40.	You can help recycle waste! Use your own creative skills to plan new uses for old items in your house or classroom.	Pencil Holder
41.	Can you think of other unusual gift wrap ideas?	Newspaper as Gift Wrap
42.	What can a glass jar be used for?	Glass Jar

43.	What could your family do with old newspaper?	Newspaper Recycling
44.	Items we can't recycle or reuse can be crushed so they will take up less space in our landfills. Small items may be crushed at home. Remember to always do this crushing carefully. Wear gloves and safety glasses when crushing metal and glass.	Automobile Being Compressed
45.	It's important for each of us to tell other people about reusing and recycling man-made materials such as plastic and glass which nature can't recycle.	Plastic Container
46.	We all need to become trash treasure hunters!	Returnable Beverage Container
47.	Won't you do your part?	School Child
48.	(Credit slide)	
49.	(Credit slide)	

Note: Asterisks (*) indicate spots where you may wish to stop the cassette for discussion.

REFERENCE ARTICLES

The following two articles are from the Phoenix Quarterly, a publication of the Institute of Scrap Iron and Steel, Inc. They are included to provide you with some pertinent background information on certain aspects of resource recovery and recycling. You will probably decide to discuss some of the more intriguing facts with your class. In any case, we highly recommend that you review each article before presenting the Level 5 Unit to your students.

Bureau of Mines Research Activities in Secondary Resource Recovery

Dr. Thomas V. Falkie

Since its creation by the Congress in 1910, the Bureau of Mines has been concerned with the refining of secondary metals such as lead, zinc, copper and brass. In recent years, we have focused attention on recovering metals and minerals from a variety of wastes, including devising methods for more effectively processing junk autos to encourage more complete recycling of metals and nonmetallic constituents.

The Bureau has developed new and better methods for processing junked motor vehicles at our Salt Lake City (Utah) Metallurgy Research Center. About nine million cars, trucks and buses are junked annually here in the United States (table 1). Approximately eight million of these vehicles are scrapped to recover the iron and steel: four million by shredding and four million by hand dismantling. However, a large proportion of the nonferrous metals and nonmetallic materials simply goes to waste. In addition, about one million junked vehicles per year are not recycled and instead enter an idle "inventory" estimated at between 12 and 20 million units.

One of the immediate problems faced by processors of obsolete cars are air quality regulations which prohibit open burning of cars. Because burning is a vital step in the preparation of junk cars for hand dismantling prior to processing in a shear or baling press, the Bureau developed an improved smokeless incinerator for automobiles which junk car processors can construct at minimal cost. Currently there are more than 30 incinerators of this design operating in the United States.

Some scrap processors mechanically shred junk cars at a rate of 25,000 to 300,000 units per year to produce fist-sized chunks of metal. The shredded material is then separated magnetically to reclaim the iron and steel, leaving a nonmagnetic fraction containing fabric, rubber, glass, plastics, and a mixture of nonferrous metals such as copper, aluminum and zinc.

TABLE 1—Junk cars

	Weight, million tons*	Units millions*
Vehicles Junked	13.5	9
Vehicles Shredded	6.0	4
Iron	4.5	—
Nonmagnetics	1.5	—
Metal	0.3	—
Glass, rubber plastics	1.2	—
Vehicles Hand Dismantled Bundled, sheared	6.0	4
Vehicles Not Processed	1.5	1

*Estimate

About 1.5 million tons of these nonmagnetic materials are generated each year, 300,000 tons of which are metals with a scrap value of at least $120 million. Several scrap shredding plants are currently recovering nonferrous metals by various separation techniques, but there remains potential valuable nonmagnetic material.

Our research has demonstrated a simple method for reclaiming a nonferrous metal concentrate from the nonmagnetic material by air classification and water separation. Furthermore, we have found that the reject coming from shredders equipped with dust collectors can move directly to the water ellutriation step. Today, there are about six commercial facilities in operation or under construction which utilize this technology. We are now investigating techniques for further separation of this nonferrous metal concentrate into aluminum, zinc and copper alloy fractions.

Because the makeup of cars is steadily changing, we foresee new and challenging separation problems when vehicles now in showrooms and on drawing boards for future production have served out their useful life and are ready to reenter the raw materials supply chain through recycling. We are now working on application of air and water separation techniques for recovery of plastics for reuse. Several late-model cars have been furnished by the automobile industry so that we can identify their materials of construction (table 2) for comparison with those of older cars now being scrapped, and can devise suitable, low-cost separation techniques. Substantial differences in the proportions of plastics, aluminum, magnesium, and low-alloy steels have already been identified, and the information is being used by our researchers.

TABLE 2—Components of a 1975 Chevrolet Caprice Station Wagon

Group Number	Component Material	Weight lb	Weight pct
1	Polyurethane foam	46.6	0.93
2	Polypropylene	37.6	.75
3	Acrylonitrile butadiene & styrene (ABS)	30.0	.60
4	Vinylized fabric	27.0	.54
5	Nylon rug	13.9	.28
6	Plated ABS	4.1	.08
7	Vinyl	6.9	.14
8	Tar-like backed felt	46.5	.93
9	Polyethylene	4.7	.09
10	Acrylic	2.2	.04
11	Nylon fabric	2.3	.05
12	Styrene	.2	.01
13	Phenolic	.3	.01
14	Bakelite	1.7	.03
15	Nylon	2.6	.05
16	Polyvinyl acetyl	.2	.01
17	Fiber	.3	.01
18	Polyester	.3	.01
19	Teflon	.1	.01
20	Mastic	5.7	.11
21	Tygon	1.4	.03
22	Cotton fabric	3.7	.07

Lead storage batteries are as ubiquitous as our automobiles. When the batteries are worn out, the lead in them is recovered for reuse. Table 3 shows how much lead and antimony (alloyed with the lead to make it stronger) is recovered. Current practice uses blast furnace smelting of lead-battery scrap to produce secondary lead, but this operation also generates sulfur dioxide. To avoid the production of this pollutant the Bureau of Mines developed a technique to tie up the sulfur with lime as calcium sulfate, before smelting. One West Coast processor added the step to his operations almost as soon as we announced its development.

As part of our program to develop new markets for scrap materials, extensive tests have been conducted to determine the optimum conditions for melting ferrous scrap in a cupola furnace. The Bureau's experimental cupola is about 18 inches in diameter and is equipped to supply preheated air. Scrap mixtures melted successfully have ranged from 100 percent auto scrap to mixtures of 60 percent un-

TABLE 3—Lead battery scrap

Number scrapped	42 million
Lead Recovered	348,000 tons
Antimony Recovered	17,000 tons

Group Number	Component Material		Weight lb	Weight pct
23	Fiberglas		2.7	.05
24	Tin		.1	.01
25	Lead		1.7	.03
26	Asbestos		2.2	.04
27	Clay		6.3	.13
28	Carbon		1.7	.03
29	Pressed paper/cardboard		8.7	.18
30	Felt		5.1	.10
31	Cotton mat		34.0	.68
32	Paper-cork		2.0	.04
33	Glass & ceramic	(Glass)	135.0	2.69
		(Ceramics)	1.4	.03
34	Light steel (< ⅛ inch thickness)		1,804.2	35.98
35	Chrome-plated steel		191.5	3.82
36	Spring steel		29.5	.59
37	Heavy iron & steel (> ⅛ inch thickness)		1,334.6	26.61
38	Cast iron		776.1	15.48
39	Aluminum		75.4	1.50
40	Zinc die cast		55.8	1.11
41	Stainless steel		5.6	.11
42	Copper & brass		51.2	1.02
43	Rubberized fabric		.8	.02
44	Rubber		208.9	4.17
45	Battery		42.2	.84
	TOTAL		5,015.0	100.00

burned cans and 40 percent auto scrap: 35 percent incinerated cans and 65 percent auto scrap; and 37 percent auto scrap. 38 percent unburned cans and 25 percent prereduced pellets. Additional coke or oxygen enrichment of the hot (600° F) air would allow use of additional cans or pellets. Research on the use of pellets is continuing. In addition, a new phase of this project has just been initiated in which chopped tires are being substituted for the coke. All of the metal melted to date meets the specifications for foundry production of gray cast iron.

While this research on scrap originating from traditional sources continues, new efforts are being made to deal with recoverable metallics in municipal solid waste.

Urban refuse is a rich potential source of recyclable minerals and metals. According to the Environmental Protection Agency, about 135 million tons of refuse—comprising household, commercial, and some industrial wastes—are collected and disposed of yearly by our cities and municipalities (table 4). These wastes contain almost 10 million tons of iron and steel, more than one million tons of nonferrous metals, about 13 million tons of glass and over 95 million tons of combustibles. The heating value of the combustibles is equivalent to about 45 million tons of coal, or more than 200

million barrels of oil per year, which could reduce our dependence on interruptible and high-cost fuels from abroad. The estimated gross value of the recoverable materials in the refuse is $1.5 billion.

TABLE 4—Urban refuse generated by the U.S.

	Millions of tons	Estimated Scrap Value $ millions
Collected and Disposed of Annually by Cities Containing:	135	
Ferrous Metals	10	$ 400
Nonferrous Metals (aluminum, copper, zinc)	1.4	435
Glass	13	260
Combustibles	102	405
Total		$1,500

Two processes have been developed in our laboratories for recovering the valuable materials from the refuse. One process is applicable to incinerated refuse and the other to treatment of the raw (unburned) refuse. Both processes employ simply techniques and equipment that have been used in the minerals processing industry for many years in recovering metals and minerals from their ores. Bureau of Mines metallurgists have taken these techniques and equipment and adapted them for the job of waste prevention.

Of the refuse generated, about 30 million tons currently are burned in some 200 municipal incinerators operating throughout the United States. Incineration is expensive, but it serves to reduce the volume of the refuse by some 90 percent. Thus, substantially less land space is required for disposal of incinerated refuse (incinerator residues), than for raw refuse.

The incinerator residue is like a mineral ore, containing iron, glass, and nonferrous metals such as aluminum, copper, lead and zinc. These components are readily separated by a series of screening, grinding, jigging and magnetic separation steps. The process has been developed in a pilot plant, capable of treating about 12 tons of residue daily, which the Bureau has been operating at its Metallurgy Research Center just outside of Washington, at College Park, Maryland.

Nationwide, most refuse—amounting to over 100 million tons per year—is not incinerated but disposed of in landfills. Treatment of this raw or unburned refuse with techniques developed by the Bureau of Mines yields a combustible fraction as well as metal and glass products. This process is being demonstrated in a pilot plant having a capacity of five tons per hour which is operating at our College Park Metallurgy Research Center.

Complementing our research on processing of urban refuse are studies aimed at increasing consumption of the ferrous fraction. The primary thrust of these efforts has been to investigate the effects of impurity elements present in unburned refuse (tin) and in incinerated refuse residues (tin and copper), on the mechanical properties of various types of cast iron and steels produced by foundries.

It was found that copper contents up to 0.65 percent and tin contents up to 0.16 percent did not affect the tensile strength of plain carbon steel. However, the yield strength of plain carbon steel increased in proportion to their copper and tin contents, and the impact strength of plain carbon steel increased with tin content.

Research on preparing ductile iron has indicated that tin contents in excess of 0.07 percent embrittles the metal. Normalizing ductile iron significantly raises its strength while concurrently restoring some of the ductility lost due to the contaminants.

Other research on preparing gray iron foundry castings indicates that copper strengthens the metal. Limiting the tin content of high strength gray

iron to 0.1 percent minimizes its adverse effect whereas tin tends to improve the mechanical properties of low strength irons.

Thus, it appears that ferrous scrap reclaimed from urban refuse can be used in limited, controlled amounts to make plain carbon steels, gray iron, and ductile cast iron.

Because of its high visibility to the general public, urban refuse has received nationwide attention but there is another major category of waste that is harder to see, though nationally significant. This category, which includes wastes generated by industrial and manufacturing operations, demands attention because of the opportunity it represents to promote wise, efficient use of mineral resources through recycling. These wastes also sometimes pose major pollution problems that could be reduced by converting pollutants and wastes to useful materials (table 5).

TABLE 5—Types of industrial wastes and valuable components

Waste	Source	Component
Slags and drosses	Smelting and refining	Lead, zinc, aluminum, copper, manganese, chromium, nickel, titanium
Waste solutions	Electroplating, etching and pickling	Cadmium, nickel, copper, chromium, cobalt, gold, silver, molybdenum, mercury
Metallurgical dusts	Smelting and fabrication	Iron, zinc, lead, copper, arsenic, antimony, bismuth, chromium, nickel, cobalt
Sludges and grinding swarfs	Machining and manufacturing	Chromium, nickel, cobalt, iron, manganese, tungsten, zircon, diamonds
Slimes and tailings	Leaching and ore treatment	Alumina, iron, copper, precious metals, phosphate, uranium
Industrial gases	Pyrometallurgical operations	Sulfur, fluorine

Parts of our research program have been aimed at recovering metals and minerals from these diverse wastes—smelter dusts, slags, chemical slurries, sludges, electroplating waste solutions, grinding swarfs and industrial gases.

Substantial progress has been made in treating some of them. For example, stainless steel flue dusts have been smelted in an electric arc furnace in combination with mill scale, coke breeze and a small amount of portland cement as a binder. Following mixing, the material is pelletized, dried and charged to the furnace. Iron and nickel plus about one-third of the chromium are reduced by the carbon and form a metal phase. Ferrosilicon is added at the end of the smelting period to reduce the chromium balance. In a recent large scale test one ton of pellets was successfully smelted to produce 1,200 pounds of an iron-nickel-chromium alloy. This alloy will be tested as an addition for the manufacturers of stainless steel in the near future.

In primary aluminum smelting operations, about 200 pounds of dross are produced for each ton of metal processed. This dross contains a significant quantity of metallic aluminum that must be recovered to maintain the efficiency of the overall smelting process. In current industrial

practice, recovering the aluminum produces a high-salt slag that is difficult to dispose of because of the possibility of water pollution. And it still contains some finely-divided aluminum that should be recovered. In cooperation with firms that process dross, we are working to improve the efficiency of aluminum recovery and to avoid the risk of water pollution. We are also looking into the practicability of alternative procedures that would bypass the high-salt slag altogether.

The progress in solid waste management to date, and the rate at which new technology is being accepted and utilized, clearly indicate that our nation is headed in the right direction. Therefore, we believe that the technologic approach should be continued. Many unsolved waste problems still require technical solutions, and much of the technology currently being developed will require large-scale demonstration as part of the technology transfer process. The Bureau of Mines intends to pursue its research activities in this important area.

From Phoenix Quarterly, Institute of Scrap Iron and Steel, Inc., Washington, D.C. 7 (3): 2-9, Fall 1975

Recycled House Explores Solid Waste Option

Architectural students at Renssalaer Polytechnic Institute in Troy, NY, have constructed a "recycled" house on the college campus in an effort to stem solid waste problems related to packaging. A program exploring the use of unmodified waste to rehabilitate urban housing led them to design and erect a single-floor dwelling made almost exclusively of discards which are available in quantity, strong enough for building purposes and uneconomical for recycling by other means.

"What is not generally realized," explains the study, headed by Associate Professor Martin Pawley, "is that the form in which much of this material is used by the container and packaging industries often incorporates sufficient volume and structural strength to be employed directly in construction." The report further points out that "most bottles are designed to withstand greater stresses during pasteurization and capping than bricks or concrete blocks undergo under normal construction loading. Most glass beverage containers over 32 ounces in capacity conform to the New York State building code for concrete blocks." Such materials recovery, furthermore, supposedly consumes far less energy than industrial recycling of the same commodities does.

The frame of the 600-square-foot building consists of cardboard tubes, four inches in diameter and formerly used as newsprint cores. Scrap steel strapping and 16-oz., non-returnable bottles secure the tubes in place. (It's estimated that 80 16-oz. bottles and 300 pounds of strapping are used throughout the structure.) Over 2,000 No. 10 cans are imbedded in cement to form the walls, and the "can masonry" is coated with a solution consisting partly of the sulfur that results when crude oil is refined to cut toxic gasoline emissions. One living room wall achieves a stained glass effect with its floor-to-ceiling expanse of vari-shaped and -colored bottles set in mortar.

The roofing consists of layers of corrugated cardboard coated with cold tar and surfaced with waste rubber. Scrap cotton polyester acts as insulation.

Material costs (adding the going price for concrete, which had been donated) came to $1,000—$1.67 per square foot.

Says Professor Pawley, "The approach has enormous potential. One of the most exciting aspects is that it can be built out of income. People wouldn't have to obtain loans to construct a home." The biggest money difficulty emerges, he explains, in accommodating utilities, which would add another $3,000. He's currently investigating means of bringing that figure down, as well as the various other possibilities described in his book, *Garbage Housing*, within the framework of a graduate course in experimental low cost construction that he teaches at Florida Agricultural and Mechanical University.

The Renssalaer Institute project is not the first structure to consist of secondary materials. Glass bottle homes built in the 19th century are still standing. More recently, "recycled" houses have been constructed in New Mexico and Virginia, but with reported costs of $13,000 and $60,000, they have proven considerably more expensive than Professor Pawley's.

From Phoenix Quarterly Institute of Scrap Iron and Steel, Inc., Washington, D.C.
7 (3): 2-9, Fall 1975

RESOURCE MATERIALS

A. Books and Other Publications

1. Asimov, Isaac. ABC's of Ecology. New York: Walker and Company, 1972.
2. Binzen, Bill. The Walk. New York: Coward, McCann and Geoghegan, Inc., 1972.
3. Bowman, Mary Lynne and Coon, Herbert L. Recycling: Activities for the Classroom. Columbus, Ohio: ERIC/SMEAC Center for Science, Mathematics, and Environmental Education, April, 1978.
4. de Leeuw, Adele and Cateau. Make Your Habits Work for You. New York: Pellegrini and Cudahy, 1952.
5. Division of Elementary Education, Virginia Department of Education, Elementary Science Guide K-7. Richmond: n.p., 1972.
6. Environmental Action Coalition. Don't Waste Waste. New York: n.p., 1973.
7. Environmental Action Coalition. It's Your Environment: Things to Think About—Things to Do. New York: Charles Scribner's Sons, 1976.
8. Environmental and Conservation Education Office, Arkansas Department of Education. Pick Up Arkansas Manual. Little Rock: n.p., n.d.
9. Environmental Education Association of Oregon. Reuse, Recycling, Reduction, Three "R's" as a Guide to the Best Use of Our Finite Resources. Eugene: n.p., 1977.
10. Fiarotta, Phyllis. Snips, Snails and Walnut Whales. New York: Workman Publishing Company, 1975.
11. Gutnik, Martin J. Ecology and Pollution/Land. Chicago: Children's Press, 1973.
12. Hamilton, Charles E. Eco: A Handbook of Classroom Ideas to Motivate the Teaching of Elementary Ecology. Stewartsville, Michigan: Educational Service, Inc., 1974.
13. Hammerman, Donald. Teaching in the Outdoors. Minneapolis: Burgess Publishing Company, 1973.

14. Harris, Joanna Chochrane. Let's Go to a Sanitation Department. New York: G. P. Putnam's Sons, 1972.
15. Harwood, Pearl Augusta. The Rummage Sale of Mr. and Mrs. Bumba. Minneapolis: Lerner Publications Company, 1971.
16. Hilton, Suzanne. How Do They Get Rid of It? Philadelphia: Westminster Press, 1970.
17. Hoff, Syd. The Litter Knight. New York: McGraw-Hill Book Company, 1970.
18. Lakewood Environmental Group. Help for a Better Environment. Denver: n.p., 1975.
19. Houston, Walter. You and Your Environment. Middletown, Connecticut: Xerox Corporation, 1971.
20. Jones, Claire; Gadler, Steve; and Engstrom, Paul. Pollution: The Land We Live On. Minneapolis: Lerner Publications Company, 1974.
21. Keep Britain Tidy. Litter: An Environmental Project. Brighton, England: Brighton Corporation, 1977.
22. Lawrence, Ester Hauser. B-9, The Hungry Metal Eater, New York: Rand McNally, 1970.
23. Leaf, Munro. Who Cares? I Do. Philadelphia: J. B. Lippincott Company, 1971.
24. Mackenzie, Joy, and Forte, Imogene. Kid's Stuff: Social Studies. Nashville: Incentive Publication, 1976.
25. McDonald Corporation. Ecology and Energy Pack. Oak Brook, Illinois: n.p., 1977.
26. Marshall, James. Going to Waste. New York: Coward, McCann and Geoghegan, Inc., 1972.
27. Miles, Betty. Save the Earth: An Ecology Handbook for Kids. New York: Alfred Knopf, 1974.
28. Milliken, Margaret. Field Study Manual for Outdoor Learning. Minneapolis: Burgess Publishing Company, 1968.
29. Nickelsburg, Janet. Nature Activities for Early Childhood. Menlo Park, California: Addison-Wesley Publishing Company, 1976.
30. Peet, Bill. The Wump World. Boston: Houghton Mifflin Company, 1970.
31. Poulet, Virginia. Blue Bug's Beach Party. Chicago: Children's Press, 1975.
32. Public Schools of the District of Columbia. Litter Control—Curriculum Guides for Elementary and Secondary Schools. Washington, D.C., n.p., n.d.
33. Shanks, Ann Zane. About Garbage and Stuff. New York: The Viking Press, 1973.

34. Shuttlesworth, Dorothy E. Litter—The Ugly Enemy. New York: Doubleday and Company, 1973.
35. Simon, Seymour. Science Projects in Pollution. New York: Holiday House, 1972.
36. Soucie, Anita. Sharing the Earth. New York: Scholastic Book Services, 1971.
37. Tiedt, Dr. Sidney and Dr. Iris M. "Conserving Natural Resources" in Elementary Teachers' Ideas and Materials Workshop. West Nyack, New York: Parker Publishing Company, 1977.
38. Tisho, Annette and Taylor, Talus. Barbapapa's Ark. Middletown, Connecticut: Xerox Educational Publications, 1974.
39. Tresselt, Alvin. The Dead Tree. New York: Parent's Magazine Press, 1972.
40. U. S. Environmental Protection Agency. Earth-Trek . . . Explore Your Environment. Washington, D.C.: U. S. Government Printing Office, 1977.
41. Wentworth, D. F.; Couchman, J. K.; Macbean, J. C.; and Stecher, A. Pollution—Examining Your Environment. Toronto: Holt, Rinehart and Winston of Canada, Limited, 1971.
42. Wright, Dare. Edith and Little Bear Lend a Hand. New York: Random House, 1972.
43. Zion, Gene. Dear Garbage Man. New York: Harper and Row, 1957.

B. Audiovisual Aids

CASSETTES

1. Sesame Street, Vo. III: People in Your Neighborhood; Somebody Come and Play; Goin' for a Ride; Trash. n.p.: Troll Associates. **Primary Grades.**

FILMS

1. Forest Murmurs. Northfield, Illinois: Perennial Education, 8½ min. Reminds the viewer of his/her responsibility for litter, showing a place of great beauty being ruined by carelessness. **Primary Grades.**
2. Help Woodsy Spread the Word. Los Angeles: Animedia, Inc. Production, 18 min. Helps children recognize pollution problems and their solutions. The film is a enjoyable musical production. **Primary through Elementary Grades.**

* 3. In the Bag. Burbank, California: Walt Disney Productions, 8 min. Features the cartoon character, Humphrey the Bear, and his problems in cleaning up a littered park. **Primary Grades.**

4. Let's Help Recycle. New York: ACI Media, Inc., 11 min. Students present solutions for recycling problems to their city council as an illustration of what children can do about recycling wastes. **Elementary Grades.**

* 5. Meecology. Lake Forest, Illinois: Peshak Films, 26 min. Portrays children from varied surroundings (rural, urban, suburban, and inner city), showing how each child relates to his environment in an ecologically productive way. (Complemented by a school teaching aid called the "McDonald's Ecology Action Pack".) **Primary through Elementary Grades.**

* 6. The Litterbug. Burbank, California: Walt Disney Productions, 10 min. When a teacher shows a film about the beauty of uncluttered landscapes, contrasted with the ugliness and danger of littered areas, Lyle is impressed with the lesson and becomes determined to stop being a litterer. **Primary through Elementary Grades.**

* 7. The Litter Monster. New York: Keep America Beautiful, Inc., 15 min. Encourages young people to look around themselves and see what they can do about litter spoiling our environment. **Elementary Grades.**

8. A Community Park. New York: Youth Film Distribution Center, 8 min. A garbage-strewn lot becomes a adventure playground because of people working together. **Elementary Grades.**

9. A Decent Burial. New York: Modern Talking Picture Service, 12 min. Explains the simplicity, effectiveness, and economy of the sanitary landfill method of refuse disposal. **Elementary Grades.**

10. A Place to Begin. New York: Keep America Beautiful, 13½ min. The citizens of Macon, Georgia speak about how the CLEAN COMMUNITY SYSTEM (a behavioral approach to changing attitudes about the handling of waste) worked in their city. **Upper Elementary through Adult.**

11. Ecology Lady. Falls Church, Virginia: Stuart Finley, Inc., 15 min. Problems of a neighborhood recycling center are revealed. **Elementary Grades.**

12. Help Yourself. Bloomington, Indiana: Indiana University Audiovisual Center, 29 min. Demonstrates how behavior is influenced by the physical and social aspects of the environment. **Elementary Grades.**

13. Money to Burn. Austin, Texas: Travel and Information Division, Texas Highway Department Film Library, 20 min. Depicts waste and the unsightliness of litter. **Elementary Grades.**
14. Resources Recovery Is . . . New York: Modern Talking Picture Service, 20 min. Major approaches to recovery of resources, featuring communities already using these methods. **Elementary Grades.**
15. Sanitary Landfill. Washington, D.C.: NACD, Distribution Branch, National Audiovisual Center, 15 min. A sanitary landfill foreman describes his job. **Elementary Grades.**
16. Sparkles. Portland, Oregon: Robert E. Landsburg, Film Productions, 15 min. Without narration this film follows drops of water down a beautiful mountain stream to the littered banks of the Columbus River. **Upper Elementary through Adult.**
17. The House That Recycling Built. Richmond, Virginia: Reynolds Metals Company, 9½ min. Shows how products of recycled materials were used in building a home. **Upper Elementary through Adult.**
18. The Trouble With Trash. New York: Modern Talking Picture Service, 28 min. Refuse problems and solutions are shown and discussed. **Elementary Grades.**
19. To Four Parts Refuse. Washington, D.C.: NACD, Distribution Branch, National Audiovisual Center, 15 min. Describes a well-planned landfill. **Elementary Grades through High School.**
*20. Wealth Out of Waste. Washington, D.C.: Bureau of Mines, U.S. Department of the Interior, 20 min. Explains secondary recovery techniques presently in use or experimentally in operation throughout the United States. **Upper Elementary through Adult.**

FILMSTRIPS

1. Far Apart. New York: Devoyer-Geppert Audiovisuals. Demonstrates the concept of "opposite." **Primary Grades.**
2. Nothing Stays the Same. New York: Denoyer-Geppert Audiovisuals. Discusses change. **Primary Grades.**
3. Our Earth. New York: Herbert E. Budeck Films and Slides. Basic concepts of ecology are highlighted. **Primary Grades.**

FILMLOOPS

1. The Trash Problem. Cambridge, Massachusetts: Ealing Film-Loops. **Primary through Elementary Grades.**

NOTE: *These films are available through the Bureau of Teaching Materials, VA. Department of Education.

The Virginia Division of Litter Control and Keep America Beautiful, Inc. (99 Park Ave., New York, New York 10016) maintain additional film lists for youth and adults.

JUNIOR ECOLOGY CLUB ORDER FORM

My students have completed the Level ____ unit of OPERATION WASTE WATCH. Please enroll my class in the JUNIOR ECOLOGY CLUB PROGRAM and send me _____ membership certificates.

☐ I plan to use the certificates to reward my students for completing the OPERATION WASTE WATCH unit.

☐ I plan to involve my class in conservation/environmental projects. Please send a list of suggested activities.

* * * * * * * * * * * * * *

Overall, I would evaluate this OPERATION WASTE WATCH unit as:

1 2 3 4 5
poor excellent

In terms of reaching the unit objectives, on the average my students did:

1 2 3 4 5
poorly an excellent job

I would rank my students' interest level in the unit as:

1 2 3 4 5
not interested very interested

I would rank my interest in teaching this unit again as:

1 2 3 4 5
not interested very interested

COMMENTS: _____

_____

_____

* * * * * * * * * * * * * *

Please send the Junior Ecology Club Membership Certificates to:

Name: _____

Position: _____

School: _____

Address: _____

Phone: _____

School Division: _____

ACKNOWLEDGEMENTS

Through the diligence and creativity of numerous individuals, the Division of Litter Control has produced a unique instructional program for the teachers and, most importantly, for the children of Virginia. Our wholehearted appreciation is extended to each individual and firm which helped make OPERATION WASTE WATCH a reality.

Our thanks go first to Drs. Edwin White and William Brown who wrote the original draft and developed our activity card format, and to Keep America Beautiful for allowing us to base OPERATION WASTE WATCH on their program, WASTE IN PLACE.

Lawler Ballard Advertising of Richmond and Norfolk produced the comic and coloring books, the posters, and all of the art work of the kits. We feel the art alone will heighten the "litter awareness" of many students and teachers. We wish to thank especially the creative and production department of Lawler Ballard Advertising for their contributions. Jon Peterson and Saul Wrenn of the Film Production Service, State Department of Education, produced our colorful filmstrips.

Several professional educators contributed their talents in evaluating the project. Teresa Auldridge and Michael Bentley of the State Department of Education provided expert critiques. Drs. Allen Turnbull, John Nezlek, and Joseph Galano of Williamsburg conducted the formal analysis of our field-testing. Dr. Richard Mercer of Richmond edited the pilot manuscript.

We also wish to thank Outdoor Biology Instructional Strategies, (OBIS), of the University of California for permission to use the Recycling Game in the Level 5 Unit. And we thank the Phoenix Quarterly for granting permission to use two articles in the Level 5 Unit.

My personal thanks go to several fellow members of the Division of Litter Control staff who contributed many hours and their "litter expertise" to the effort: Ginger Raymond who assisted in all aspects of production; Janet Wynne, Crystal Belt, and Mollie Osborne who typed the manuscript; and our Commissioner, Robert W. Slocum, who made it all possible.

Finally, we wish to recognize and thank all those individuals who participated in the field testing of OPERATION WASTE WATCH: the local coordinators, principals, and above all, the

teachers who provided invaluable suggestions for refining the program.

The following local school systems were involved in this pilot program: Accomack County, Albemarle County, Arlington County, Colonial Heights, Fairfax County, Franklin County, Hanover County, Henry County, Lynchburg, Martinsville, Nelson County, Northampton County, Roanoke, and Virginia Beach.

The enthusiasm of students and teachers who field-tested OPERATION WASTE WATCH reinforces our conviction that the curriculum will provide an exciting and important program of study for the children of Virginia.

Jan Robertson
Virginia Division of Litter Control

LEVEL 5
TEACHER CARD
OPERATION WASTE WATCH
VIRGINIA DIVISION OF LITTER CONTROL

Trash Treasures Individual Activity Cards

Introduce the INDIVIDUAL ACTIVITY CARDS (IACs) after all the students have seen the filmstrip. The 13 IACs are designed for use by small groups of children or individual students. However, the IACs may be used as total class activities, if it is not feasible to carry out individual or small group activities with your class. Most of the Level 5 IACs need not be completed in numerical sequence.

There are several ways to use the IACs:

1. **One group of students could work with you** on a few cards while an aide or other adult uses some other cards with another group.
2. Three or four IACs at a time could be placed in a **Learning Center.**
3. Small groups of students could choose 1 activity and then make a **group report to the class.** You may wish to duplicate additional sets of cards so that several children can work on the same card simultaneously.
4. If a cassette player is available, you may decide to **put the IACs on audiotape.**

We recommend that each student complete the IACs before the CLASS ACTIVITY CARDS (CACs) are introduced. Cards containing more difficult activities are marked with asterisks (*) in the upper right-hand corners.

To shorten the unit, we suggest you use only the CORE ACTIVITY CARDS. Core cards are labeled CORE in the upper left-hand corners.

IDEA AND OBJECTIVE NOTATIONS REFER TO NUMBERED IDEAS AND UNIT OBJECTIVES ON PAGES 1 AND 2 OF THE TEACHER GUIDE.

CORE

Visitor From Outer Space

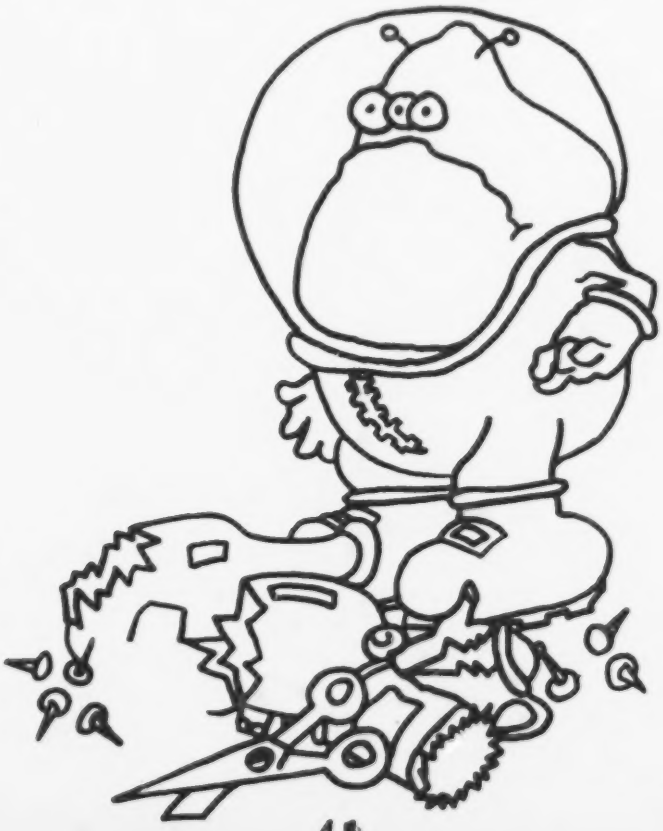
Pretend that a visitor from another planet comes to earth.

Pretend that his/her spaceship landed in a football stadium after a game.

He/she sees candy wrappers, hot dog wrappers, soft drink cups, and other wastes littered all over the empty stands. He/she sees no people.

Make up a short story about what the space visitor might think about the creatures who live on earth. What might he/she tell the folks at home about "earth people."

Write your story on notebook paper. If you like, draw a picture to go with the story. Give your paper to your teacher.



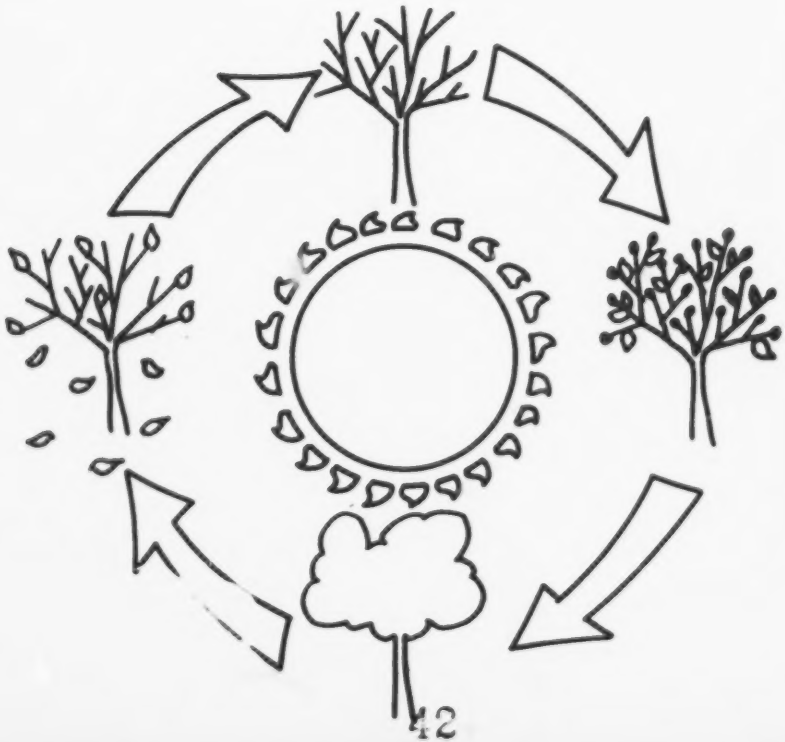
CORE

Round-and-Round

Many natural and man-made events occur in cycles. Think about the cycles you saw in the filmstrip. The seasons—autumn, winter, spring, and summer—illustrate one cycle.

Write a list of as many cycles as you can think of. Compare your list with those of other students. Give your list to your teacher.

Examples:
1. season cycle
2. aluminum can cycle
3. _____
4. _____
5. _____
6. _____, etc.



Pantomime

Choose one cycle, such as the season cycle, the corn-grasshopper-frog-hawk cycle, or the aluminum can cycle. With 4 or 5 classmates, plan a **pantomime**—a skit without speaking—about the cycle.

Present the **pantomime** to the whole class. Ask the class to name the cycle you acted out.

CORE

Inventor at Work!

Pick up 3 objects in your classroom which are examples of **solid waste** (useless, unwanted, or discarded materials).

Put the 3 objects on your desk. Think about **new** things you might be able to make from these waste objects. Make a small drawing of each of the waste objects. Now make a small drawing of the new thing you would make out of each object. Label each drawing. Give your paper to your teacher. Ask your teacher to display your drawings in the classroom.

Example:

COFFEE CAN PENCIL HOLDER

Be a Sculptor

You will need the following items:
6 empty aluminum cans
1 daily newspaper
strong glue.

Bring these objects from home or get them from your teacher. Create a sculpture from the items above.

Write a TITLE for your sculpture on a small piece of cardboard. Display your creation in the classroom with the title placed in front of the sculpture.

Go on to IAC-6/13

A Limerick

Write a limerick or another type of funny poem about your sculpture. See IAC-5. If you didn't make a sculpture, write a poem about recycling.

An example of a limerick:

There was a young lady from Niger,
Who smiled as she rode on a tiger;
They returned from the ride,
With the lady inside,
And the smile on the face of the tiger.

—Anonymous

Sell It!

Pretend that your job is to convince a group of people that they should recycle a certain product (for example: paper or aluminum cans). Write a 2-minute **commercial** to "sell" your idea (about 1 page long). The commercial may be serious or humorous. Make it for either radio or television.

Decide if the group of people you are trying to "sell" the idea to are children, teenagers, adults, or older folk. Make your commercial fit the age group you decide on.

Present the commercial to your family and class as if you were reading it over the radio or acting it out on television. Give your written commercial to your teacher.

Symbols

"Smokey the Bear" is a **symbol** which reminds people to help prevent forest fires. "Energy Ant" is a symbol for energy conservation. This is the symbol for the Virginia Division of Litter Control:

Create a symbol to remind people to recycle something. Make a large drawing of your symbol for your classroom, school, or neighborhood. With your teacher's help, decide on a good place to hang your drawing.

Resource Recovery

RESOURCE RECOVERY means **taking useful objects out of the trash to recycle them.** For example, large **magnets** can be used by a community's solid waste department to pick up and remove **steel cans** from the trash. This steel can then be recycled to take other steel products.

Can you think of a way to remove paper? How can aluminum and glass be removed?

RESOURCE RECOVERY is very expensive right now. But in the future many communities may use this process. Do you think it is a good idea? Ask your teacher to help you find some more information on RESOURCE RECOVERY.

Changing Habits at Home

Most people have a habit of putting all their household trash together in 1 trash can. The aluminum, paper, food scraps (**organic waste**), and plastics all go in together. Can you think of a RESOURCE RECOVERY SYSTEM for your own home?

Write down your ideas and give your paper to your teacher.

Moo!

Not long ago all milk was sold in reusable glass containers. The milkman brought the milk to each house in glass bottles. He took away the empty bottles to be washed and refilled with milk.

1. Why do you think we stopped using this system in the United States? Would it be hard to go back to this system now? Why?
2. Think about the time it took for the milkman to make all the deliveries. Think about the time and money it cost to clean the bottles. Think about the gasoline the milkman needed for his truck. Was it a lot of trouble to deliver milk?
3. Do you think we should start using glass milk bottles which we would buy in the stores and return to the stores to be washed and reused? Why or why not?

Write the answers to the questions above on your paper. Give your paper to your teacher.

Pencil Parts

Look closely at a pencil. On your paper list all the parts, such as "lead," "eraser," "paint," "wood," "eraser band."

List the raw materials used to make each part of the pencil (for example, wood from trees). Also, list the part of the United States or of the world where the raw materials probably came from. Are any materials in a pencil recyclable or reusable?

You may find some information to help you in the school library.

You may ask your teacher or the librarian for the name and address of a pencil company to write to for information.

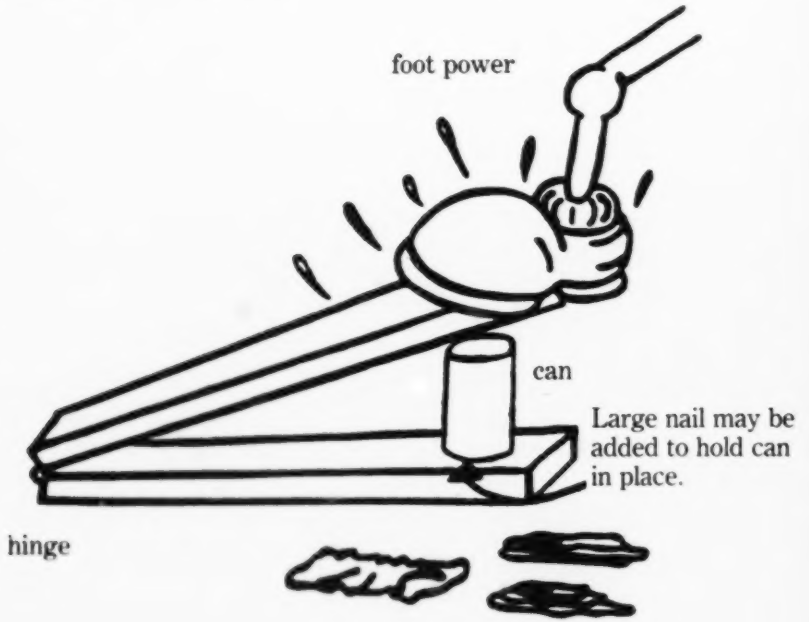
When you have finished, give your **Pencil Report** to your teacher.

Crunch!

Many people who decide to recycle aluminum find they have too little space to store the cans.

You can decrease the amount of storage space needed by crushing the cans. You need a heavy-duty hinge, two 2" x 4" boards each about 3 feet long, to build the can-crusher machine below. What would you call this machine?

We hope your family will decide to recycle aluminum cans. Find out if there is a recycling center near your home. You can get money for aluminum at a recycling center. You will be helping to recycle a valuable resource.



LEVEL 5
TEACHER CARD
OPERATION WASTE WATCH
VIRGINIA DIVISION OF LITTER CONTROL

Trash Treasures
Class Activity Cards

The 19 CLASS ACTIVITY CARDS (CACs) are designed for use by a large group of students or the whole class. These cards represent a suggested outline of activities to develop the major ideas of recycling and resource recovery. The CACs may be used before or in conjunction with the IACs.

To shorten the unit, use only the CORE ACTIVITY CARDS. These cards are labeled CORE in the upper left-hand corners. Materials that you will need are listed on each card. Note that CACs 4-14 (Food Chain Game) describe one activity and must be completed in numerical sequence. The Food Chain Game is from the **Outdoor Biology Instructional Strategies** (OBIS) kit of the University of California, Lawrence Hall of Science, Berkley.

Duplicate the Vocabulary Worksheet for each student for CAC-3.

IDEA AND OBJECTIVE NOTATIONS REFER TO NUMBERED IDEAS AND UNIT OBJECTIVES ON PAGES 1 AND 2 OF THE TEACHER GUIDE.

OPERATION WASTE WATCH
LEVEL 5

CAC-1/19
IDEAS 3, 5
OBJECTIVES 2, 4, 5

CORE

Useful Creativity

Ask each student to keep a running list throughout the unit of all items they see at home or littered in the environment which could be recycled or reused. Ask the children to list beside it the material the object is made from, where the object was found, and the new use for each object. At the end of the unit, ask the class to give short presentations explaining their ideas. Give a prize to: (1) the student with the **longest list;** and/or (2) the student with the **most useful ideas;** and/or (3) the student with the **most creative recycling ideas.**

Inventor of the Week

Each week, ask the children to design one useful object by recycling packaging items. Ask them to bring their useful objects to class each Monday.

Help the class select an "Inventor of the Week" or the "Top Inventors of the Week." Display the objects, along with photos of the inventors, in the classroom, hallway, or principal's office.

Ranger Rick's Nature Magazine has two reprints available free of charge entitled "Recycling," and "Recycle for the Birds," which have many creative and helpful ideas. Write to:

National Wildlife Federation
1412 16th Street N.W.
Washington, D.C. 20036

Vocabulary

Duplicate a copy of the VOCABULARY WORKSHEET for each student.

After the students complete the sheet independently, discuss their responses in class.

CORE

Food Chain Game

MATERIALS YOU WILL NEED:

3 or 4 liters of popped corn
1 plastic sandwich bag for each of ⅔ of the total number of students
1 roll of 1" wide masking tape
Cloth sashes for students: (at least 16 cloth sashes of one color for "grasshoppers"; 10 sashes of a second color for "frogs"; and 10 sashes of a third color for "hawks")
Playground or lawn space, about 15 meters square

Go on to CAC-5/19

OPERATION WASTE WATCH **CAC-5/19**
LEVEL 5

CORE

GAME STRATEGY:

1. Put a piece of 1" wide masking tape on each sandwich bag, with the bottom of the tape exactly 4 cm. up from the bottom of the bag.
2. Spread some of the popcorn over the lawn area. The popcorn represents **food that grasshoppers eat.**

Go on to CAC-6/19

CORE

3. Give ⅓ of the children a sandwich bag and a "grasshopper" sash. Instruct them to tie the sashes around their waists. Tell them that when the game begins, they—the grasshoppers—will put popcorn into their bags. This represents grasshoppers **eating** corn.
4. Give another ⅓ of the group sandwich bags and "frog" sashes to wear.
5. Give the remaining ⅓ "hawk" sashes to wear.

Go on to CAC-7/19

CORE

6. Explain that when the action starts, frogs will try to "eat" (tag) grasshoppers, and hawks will try to "eat" (tag) frogs. **Grasshoppers can only eat plants (popcorn) from the lawn, frogs can only eat grasshoppers, and hawks can only eat frogs.**
7. When a frog tags a grasshopper, the frog should empty the grasshopper's **popcorn** into his or her own plastic bag. (The plastic bags represent stomachs.) When a hawk captures a frog, **the hawk takes the plastic bag and the popcorn away from the frog.**

Go on to CAC-8/19

CORE

8. Start the game by saying, "Now get something to eat without being eaten." When a grasshopper or frog is tagged, he/she should leave the playing area. The first round will probably end in a few seconds with one of 2 things happening—the grasshoppers are "gobbled up" before they have a chance to eat the popcorn, or the frogs are "gobbled up" and the grasshoppers continue to eat and get fat! The children will need to practice "eating" (tagging) and "not being eaten" several times before they become adept at both.

Go on to CAC-9/19

CORE

In the game, for a grasshopper to **"survive,"** popcorn must fill its "stomach" (bag) to the **bottom** of the tape (4 cm.). For a frog to survive, popcorn must fill its bag to the top of the tape (6½ cm.). Hawks must have at least the **equivalent** of one frog with sufficient food (6½ cm.) to survive.

At the end of a round, animals which don't survive must join the tagged animals on the sidelines.

Go on to CAC-10/19

CORE

9. Repeat the action from the very beginning many times **until a balance is achieved.** You will have to modify the rules to reach a balance.
   Explain to the children that animals in a natural setting have to constantly think about getting food and not getting caught themselves.
   A **balance** in the popcorn-grasshopper-frog-hawk system means only 1 hawk for each 2 frogs and 2 grasshoppers survives. One hawk instead of 2 remain because **in nature** a hawk may easily have a mate fly in to join the hunt.

Go on to CAC-11/19

CORE

10. Encourage the children to offer suggestions between rounds on how to change the rules of behavior and/or the number of each kind of animal in order to achieve a balance. Encourage them to discuss things in nature which help animals survive.

    Possible changes:
    a. Change the numbers of hoppers and/or frogs and/or hawks. (HINT: You will need a **greater** number of grasshoppers than of the other animals to achieve a balance.)
    b. Provide **safety zones** for frogs and/or grasshoppers.
    c. Spread out more popcorn.
    d. Use a "time-release" pattern: e.g., let grasshoppers go out first to eat alone for a minute. Then release the frogs and later the hawks.

Go on to CAC-12/19

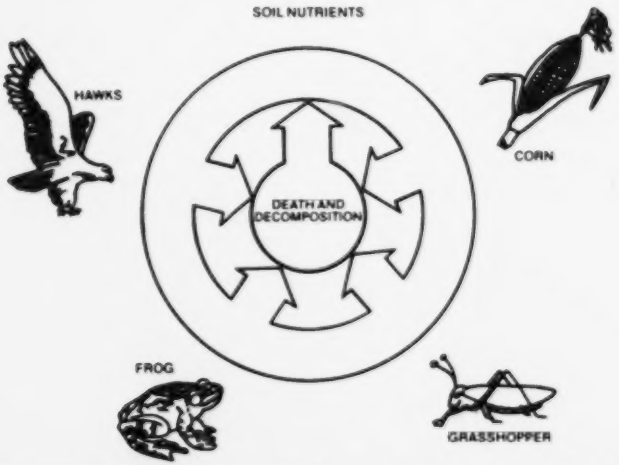
CORE

Back in the Classroom

11. Diagram on the board the food chain using the numbers of each animal which remained when a balance was reached:

Example: popcorn—grasshopper—frog—hawk
6 **6** **3**

Explain the food chain idea. A food chain is really a type of **natural cycle** (a nutrient recycling pathway).



When a hawk dies, its body decomposes (rots or biodegrades). Tiny plants and animals (bacteria and fungi feeders) in the soil make the hawk's body decompose. The nutrient (food) energy from the hawk's body goes into the soil through the action of these tiny creatures. And the nutrients which came from the hawk will help feed new plants, including new corn plants. The nutrients are **recycled** in this food chain cycle.

The nutrient (food) energy passes from the soil to the corn plant making the corn plant healthy and strong. Then the food energy passes to the grasshopper when it eats the corn. This energy keeps the grasshopper alive and strong. The food energy goes to the frog when it eats the grasshopper. It goes to the hawk when the hawk eats the frog. Then eventually, it goes back into the soil again.

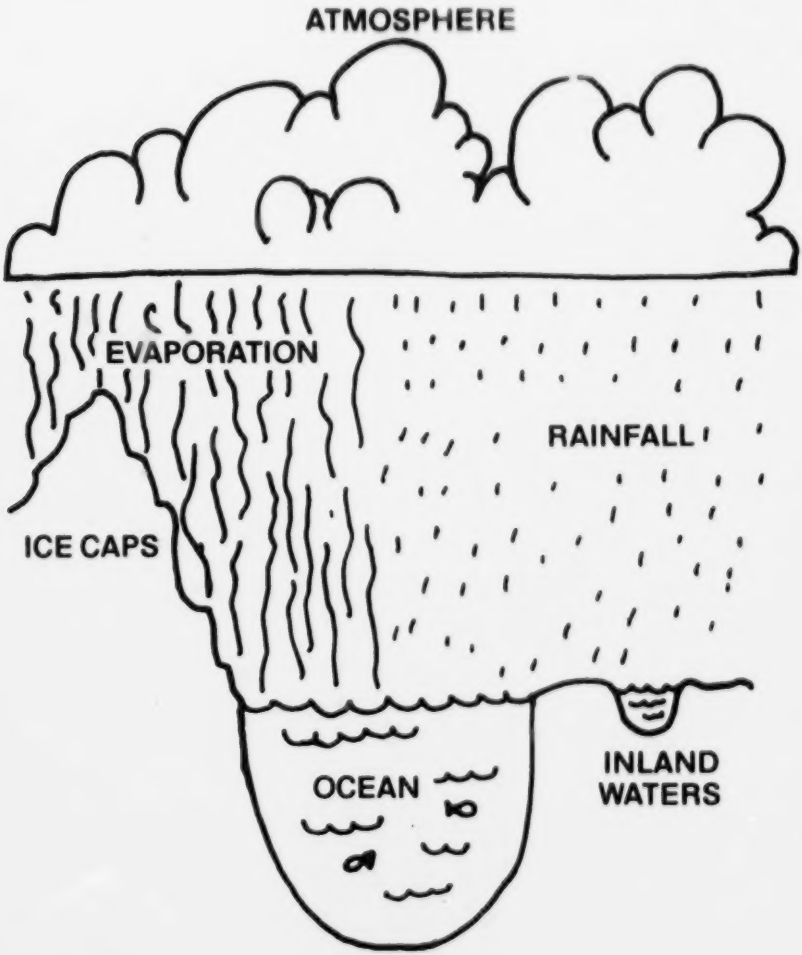
CORE

Lead a class discussion, including the following questions:

1. What would happen if we used only half as many pieces of popcorn in our game?
2. If there were no frogs, what would happen to the corn plant population? The grasshopper population? The hawk population?
3. What are some food chains which include people?

Water Cycle

Below is illustrated another cycle. Draw it on the board or duplicate it for the students. Ask the students to describe how this cycle is similar to the nutrient recycling pathway (food chain):



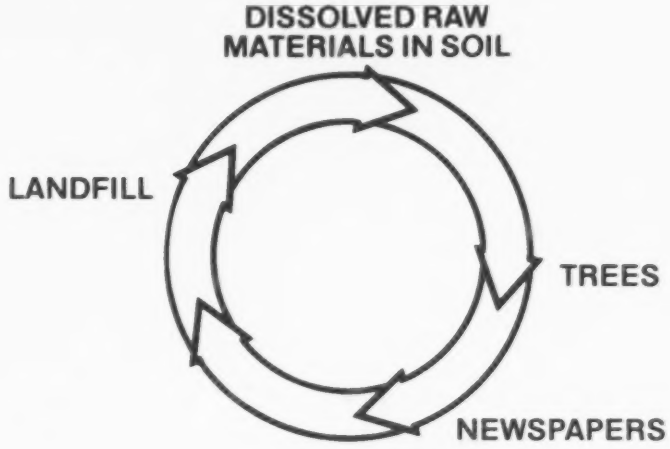
OPERATION WASTE WATCH
Level 5

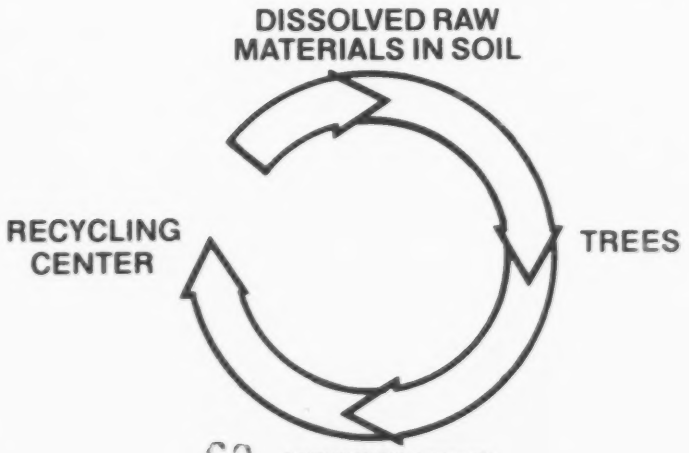
CAC-15/19
IDEAS 2, 5
OBJECTIVES 2, 3, 4

CORE

Newspaper Cycle

As a class, construct a cycle for a piece of newspaper. Two possible cycles follow:





Construct a cycle for an aluminum can. Ask the students what happens at point "A" in the cycle with something that is not biodegradable, such as an aluminum can.

Energy Recovery

Discuss the idea of burning refuse. When some wastes are incinerated (burned), heat energy can be recovered. Assist the students in drawing the following **energy recovery system** on the board:

Secondary Resource Recovery

During your class preparation time, read the article "Bureau of Mines Research Activities in Secondary Resource Recovery" by Dr. Thomas V. Falkie.

Then discuss sections of the article with your class. For example, encourage them to use their imaginations when they think about the solid waste created in our nation. Ask them:

How much is a million? Now think about 135 million tons of refuse!

A Recycled House

During your class preparation time, read the article "Recycled House Explores Solid Waste Option."

Later, discuss the article with your students. Ask them these questions:

1. Do you think it would be possible to build many houses like this? Why or why not?
2. Do you think special construction workers would be needed to build this type of house?
3. Could this type of building be used for other purposes besides houses, for example, warehouses?
4. Would you like to live in a house like this?

Optional:

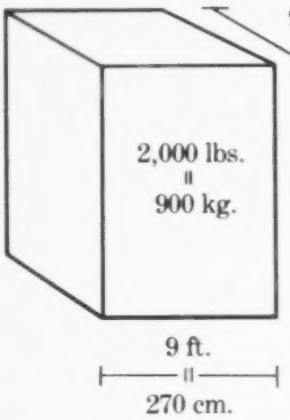
Help the class build a model recycled house. Use small containers such as frozen juice cans.

OPERATION WASTE WATCH
Level 5

CAC-19/19
IDEAS 3, 4, 5
OBJECTIVES 2, 3, 4

CORE

400 Billion Pounds of Garbage



This is how much solid waste each person in the United States generates every year! (1973)

This is about 400 billion pounds of garbage a year for all Americans. It is enough to bury Manhattan Island to a depth of 13 feet.

If possible, have the students create a system in your classroom to separate the various components of classroom refuse. Take the recovered items such as aluminum, paper, or glass to a recycling center in your community.

(Contact your local litter control program leader to find out where to take items for recycling.)

A Generous Idea

With the money collected, let the students do something nice for someone in your community, while keeping it a secret. After they have done this, ask the class to make a list of the feelings that they had while keeping the secret. Ask the class what they found out about themselves by doing something nice for someone else and by having to keep it a secret. Ask them what makes keeping a secret difficult.

END

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March 29, 1991